

# **Virginia Water Resources Research Center**

## **Annual Technical Report**

### **FY 2002**

## **Introduction**

The Virginia Water Resources Research Center (VWRRC) is both a federally authorized program within the U.S. Department of Interior under the U.S. Geological Survey and a state agency under the code of Virginia. The VWRRC is administered by the Research Division at Virginia Tech.

Activities and programs of the VWRRC are in accordance to its legislative mandate and mission statement: The VWRRC provides research and educational opportunities to university faculty and students; promotes research on practical solutions to water resource problems; and facilitates the timely transfer of water science information to decision-makers.

The VWRRC no longer completely relies on the 104 base grant funding to support its programs. However, the availability of 104 funds is critical to program development and management of the VWRRC. The 104 funds have been instrumental in increasing the university (Virginia Tech) and state commitment to the programs of the VWRRC. The funds are also offered (and serve) as evidence of federal-state partnership. Less restrictive 104 funds can be used as match for fund raising efforts and supplement other funding sources. The VWRRC seeks project specific external funding in collaboration with the university faculty and plays a leadership role to facilitate funding from external sources.

During the FY 2002 reporting period, the 104 funds were dedicated to the outreach function of the VWRRC. The VWRRC used its 104 funds to publish and distribute its newsletter (Virginia Water Central), to further develop, update and maintain its Website, and to support its internal operations. Supplemental funds added to the base grant by state agencies were used to conduct studies of TMDL program, capacity development for small water systems, and to provide administrative support to the Virginia Water Monitoring Council. During the reporting period, the VWRRC used its state allocation to fund several state-wide competitive grants (up to \$25,000) and seed grants (up to \$5,000). The VWRRC also provided, on a competitive basis, several undergraduate research fellowships, summer internships, and one graduate fellowship. The VWRRC organized its annual water research symposium and facilitated several workshops and seminars.

During the FY 2002 reporting period, the VWRRC facilitated three supplemental grants. Two of these projects were funded by the US Army Corps of Engineers.

## **Research Program**

During the reporting period, the VWRRC used its state allocation to fund three state-wide competitive grants (up to \$25,000) and four state-wide seed grants (up to \$5,000).

In-House research activities (funded through programs other than 104 funds) undertaken and completed by the VWRRC staff and affiliated faculty during the reporting period were: 1. Developing benthic TMDL reports for six impaired stream segments; 2. Capacity development for small drinking water systems; and 3. Stream corridor assessment for the Stroubles Creek watershed.

## PUBLICATIONS

### 1. Book

Younos, T. (Editor) 2002. *Advances in Water Monitoring Research*. Water Resources Publications LLC, Highlands Ranch, CO. ISBN Number 1-887201-33-5. 231 p.

### 2. Refereed Journal Articles

Younos, T., R. De Leon and C. Lewicki. 2003. Integrating Service-Learning Into Watershed Management Programs: Opportunities and Challenges. *JAWRA* 39(1)1-5.

Bosch, D.J. and J.W. Pease. 2002. Economic Risk and Water Quality Protection in Agriculture. *Review of Agricultural Economics* 22(2):438-463.

Crowder, D.W. and P. Diplas. 2002. Assessing Changes in Watershed Flow Regimes with Spatially Explicit Hydraulic Models. *JAWRA* 38(2):397-408.

Darken, P., C. Zipper, G. Holtzman and E. Smith. 2002. Serial Correlation in Water Quality Variables: Estimation and Implications for Trend Analysis. *Water Res. Research* 38(7)22-1 to 22-7.

Speir C. and K. Stephenson. 2002. Does Sprawl Cost Us All? Isolating the Effects of Housing Patterns on Public Water and Sewer Costs. *APA Journal* 68(1):56-70.

Zipper, C., G.I. Holtzman, P.F. Darken, J.J. Gildea and R.E. Stewart. 2002. Virginia USA Water Quality, 1978 to 1995: Regional Interpretation. *JAWRA* 38(3):789-802.

### 3. Book Chapter

Younos, T. and J.L. Walker. 2002. Evaluation of Biological Assessment Data and Protocols for TMDL Reports. In: *Universities Contribution to TMDL Program Development* (T. Younos, Editor). Water Resources Update (Peer Reviewed Issue) No. 122, The Universities Council on Water Resources, Southern Illinois University, Carbondale, IL. pp. 47-54.

### 4. Dissertations

Long, G.R. 2002. Determination of Environmental Stressors Influencing Benthic Invertebrate Community Structure: A Multivariate Statistical Approach. M.S. Thesis in Biology, concentration in Environmental Science and Policy. George Mason University.

Krause, C.W. 2002. Options for Modeling and Managing Stream Temperature in the Face of Increasing Water Demands and Minimum Instream Flows. M.S. in Fish and Wildlife Sciences, Virginia Tech.

Young, M. M. 2002. Cooperative Infrastructure for Small Water Systems: A Case Study. M.S. Thesis in Agricultural and Applied Economics, Virginia Tech.

#### 5. Water Center Special Reports

Loganathan, G.V., H.D. Sherali, S. Park and S. Subramanian. 2002. SR20-2002. Optimal Design Rehabilitation Strategies For Reliable Water Distribution Systems. Available on the Water Center Website: [www.vwrrc.vt.edu/publications/special\\_reports.htm](http://www.vwrrc.vt.edu/publications/special_reports.htm)

Young, M.M. 2002. SR22-2002. Cooperative Infrastructures for Small Water Systems: A Case Study. Available on the Water Center Website: [www.vwrrc.vt.edu/publications/recent.htm](http://www.vwrrc.vt.edu/publications/recent.htm)

#### 6. Conference Proceedings

De Leon, R. and T. Younos. 2002. Integrating Student Service-Learning and University Knowledge into Watershed Management Programs: The Stroubles Creek Watershed Case Study. In: Proceedings (CD) of the 7th National Watershed Conference, Richmond, Virginia. pp. 93-102.

Walker, J.L., K.R. Porter and T. Younos. 2002. Monitoring Needs to Meet Benthic TMDL Requirements. Proceedings of the 2002 National Monitoring Conference. Madison, WI.

#### 7. Other Reports

VWRRC. 2002. Benthic TMDL Reports for Six Impaired Stream Segments in the Potomac-Shenandoah River and James River Basins. 210 pages. Submitted to Virginia Department of Environmental Quality. <http://www.deq.state.va.us/tmdl/tmdlrpts.html>

Culver, T.B. 2002. Demonstration and Evaluation of Optimal Design Tools for Determination of TMDL Allocations. Final Report submitted to Virginia Water Resources Research Center. 44 p.

Zipper, C., P. Donovan-Ealy and T. Dillaha. 2002. Identifying Critical Sediment-Source Areas in the Clinch-Powell Basin: Little River Feasibility Study. Final Report submitted to Virginia Water Resources Research Center and The Nature Conservancy. 52.

Hallerman, E.M., K. Finne and M. Culver. 2002. Evaluation of PCR Assays for Escherichia coli Strains for Identifying Sources of Coliform Contamination. Final Report submitted to the Virginia Water Resources Research Center. 7 pp.

# Phytoremediation of Organic Contaminants in Soils and Ground Water

## Basic Information

<b>Title:</b>	Phytoremediation of Organic Contaminants in Soils and Ground Water
<b>Project Number:</b>	2002VA13S
<b>Start Date:</b>	5/1/2001
<b>End Date:</b>	9/30/2004
<b>Funding Source:</b>	Supplemental
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Biological Sciences
<b>Focus Category:</b>	Water Quality, Groundwater, None
<b>Descriptors:</b>	phytoremediation, organic contaminants, groundwater
<b>Principal Investigators:</b>	Tamim Younos, James A Smith

## Publication

1. Buckels, J.L., 2003, Quantification of contaminant Uptake by Plants and Evaluation of a Partition-Limited Equilibrium Model, Master of Science thesis, Dept. of Civil Engineering, University of Virginia, 64 p.
2. Wenk, T.F, 2003, Testing and Validating a Partition-Limited Model for the Uptake of MTBE by Various Plants, Master of Science thesis, Dept. of Civil Engineering, University of Virginia, 43 p.

This work represents a joint collaboration between Dr. Cary Chiou of the National Research Program of the USGS and Dr. James Smith of the University of Virginia. Recently, Chiou et al. (2001) have developed a new model to describe the uptake of organic contaminants from soil and ground water by plants. The model is relatively simple to implement, and is based on equilibrium-driven partitioning of the organic contaminant between water and specific organic components (e.g., lipids and carbohydrates) present in any location of the plant. The model is compatible with limited plant-uptake data in the literature. However, it has not been rigorously tested by extensive data to verify many important implications of the model field applications. The primary objective of this work is to perform a series of laboratory experiments to validate (or invalidate) this new model. These data and model results will be of primary benefit to engineers designing phytoremediation systems for shallow soil and ground water contaminated with organic pollutants. The results will improve our understanding of levels of crop contamination by pesticides for different crops in various contaminated soils.

# Modernizing US Army Corps of Engineers Policies and Programs

## Basic Information

<b>Title:</b>	Modernizing US Army Corps of Engineers Policies and Programs
<b>Project Number:</b>	2002VA14S
<b>Start Date:</b>	3/1/2001
<b>End Date:</b>	2/28/2005
<b>Funding Source:</b>	Supplemental
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Social Sciences
<b>Focus Category:</b>	Law, Institutions, and Policy, None, None
<b>Descriptors:</b>	policy, ecosystems, global warming, shoreline erosion
<b>Principal Investigators:</b>	Tamim Younos

## Publication

1. William C. Holiday. 2002. White Paper on Revitalization of Corps of Engineers Projects. Working Draft Report for Institute for Water Resources, U.S. Army Corps of Engineers. 62 pp.

US Army Corps of Engineers (Corps) policies, program and budget have been under increased review by the public, Congress, and the administration. Policy and planning for civil works projects have been described as confusing and needing modernization to reflect current state of the art planning practices. The Virginia Water Resources Research Center conducts policy reviews and applied research on planning for each of the following four efforts:

1. Produce background documents upon which can be developed a uniform rationale and procedure for monetary and non-monetary evaluation of ecosystem benefits and costs.

2. The Corps is developing a Corps Environmental Performance Atlas (CEPA) as an online tool for analyzing, managing, and improving the Corps environmental performance. CEPA will help Corps analysts collect and compare information on environmental issues and the Corps environmental programs. There is a need to analytically review Corps environmental project reports, i.e., to extract specific information on economic valuation of environmental features of Corps projects. This review will be utilized in finalizing the final format for the CEPA. The purpose of this study is to review Corps environmental project reports to identify the types of data might be available, the level of detail, and excerpt information related to economic valuation of environmental features, benefits, and costs of projects.

3. Carbon dioxide is included in the category of greenhouse gases that are believed to contribute to global warming. The possible consequences of climate change caused by greenhouse gas emissions present Corps planners with the question of how to incorporate consideration of project-induced changes in carbon emissions or sequestration rates in the project planning process. This study will consider how the effects of project-induced sequestration or release of carbon might be accounted for in the process of project formulation and evaluation according to the planning framework established by the Economic and Environmental Principles and Guidelines for Water Related Land Resources Implementation Studies.

4. The role and magnitude of Federal agencies in shore protection is a contentious issue and frequently modified by Federal legislation. The most comprehensive survey of shoreline change was the 1971 National Shoreline Study conducted by the Corps. That report identifies categories of shoreline erosion and associated development patterns. This study will review and update the 1971 National Shoreline Study Report. The review will focus on the "critical erosion" category to look at changes in development patterns for those areas.

# Multi-Institute Bacterial Source Tracking Project

## Basic Information

<b>Title:</b>	Multi-Institute Bacterial Source Tracking Project
<b>Project Number:</b>	2002VA15S
<b>Start Date:</b>	1/1/2002
<b>End Date:</b>	12/31/2004
<b>Funding Source:</b>	Supplemental
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Water Quality
<b>Focus Category:</b>	Methods, Non Point Pollution, Surface Water
<b>Descriptors:</b>	bacteria, E.coli, fecal contamination, source tracking
<b>Principal Investigators:</b>	Tamim Younos, Charles Hagedorn

## Publication

The purpose of this multi-institute project is to compare four methods of Bacterial Source Tracking (BST) to identify sources of fecal pollution. Methods to be studied include: Carbon source utilization of bacterial source samples; Pulsed-field gel electrophoresis analysis of bacterial source samples; Ribotyping of bacterial source samples; Antibiotic resistance analysis of bacterial source samples.

Information and knowledge gained from this study will advance field and analytical methodologies of bacteria source determination in natural waters. The evaluation and comparison of bacteria source tracking methods will provide information that will help other investigators across the nation choose appropriate techniques for determining sources of bacteria in natural waters.

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## **Information Transfer Program**

During the FY 2002 reporting period, the VWRRC used its 104 funds to support publishing of its newsletter (Virginia Water Central), to further develop and update its Website, and to support the program development for the Service Training for Environmental Progress (STEP) a community outreach program of the Water Center.

# Information Dissemination

## Basic Information

<b>Title:</b>	Information Dissemination
<b>Project Number:</b>	2002VA2B
<b>Start Date:</b>	3/1/2002
<b>End Date:</b>	2/28/2003
<b>Funding Source:</b>	104B
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Not Applicable
<b>Focus Category:</b>	, None, None
<b>Descriptors:</b>	
<b>Principal Investigators:</b>	Tamim Younos

## Publication

1. Virginia Water Central Newsletter
2. Newsletters.

a. Water Center Newsletter

Virginia Water Central, published four to five times per year, is a newsletter on water-related issues in Virginia. The length varies from 12 to 28 pages but the average length is 16 to 20 pages. As of June 2003, the newsletter mailing list included approximately 2400 recipients of paper copies and 320 recipients of an email notice sent whenever a new issue has been posted on the Center's Website. In addition, the 13 copies of the newsletter is mailed to campus departments and 20 copies to the library of Virginia for distribution to the state depository libraries. The newsletter is available on Water Center's Website:  
[www.vwrrc.vt.edu/central/virginia.htm](http://www.vwrrc.vt.edu/central/virginia.htm).

b. Web-Based Daily News

News about water-related issues from regional newspapers is gathered and posted on the Water Center Website on a daily basis. Daily News is a very popular feature of Water Center Website. Daily News can be located on the Water Center Website: [www.vwrrc.vt.edu/news/daily.htm](http://www.vwrrc.vt.edu/news/daily.htm).

c. Short Courses and Workshops

Virginia Water Research Symposium 2002, November 7-9, 2002, Richmond, Virginia. Attendance: 130

Seminars and Forums to Celebrate the 30<sup>th</sup> Anniversary of the Clean Water Act. October 15 to October 18, 2002 on Virginia Tech Campus. Approximate Attendance: 200.

## Student Support

<b>Student Support</b>					
<b>Category</b>	<b>Section 104 Base Grant</b>	<b>Section 104 RCGP Award</b>	<b>NIWR-USGS Internship</b>	<b>Supplemental Awards</b>	<b>Total</b>
<b>Undergraduate</b>	0	0	0	21	21
<b>Masters</b>	0	0	0	13	13
<b>Ph.D.</b>	0	0	0	1	1
<b>Post-Doc.</b>	0	0	0	0	0
<b>Total</b>	0	0	0	35	35

## Notable Awards and Achievements

## Publications from Prior Projects